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# General Notes.

## GEOGRAPHY AND TRAVEL.

Chatham Island, Galapagos Archipelago, Aug. 28, 1891.

Having returned from a trip of two months through the Galapagos Islands, I take the opportunity to send you a few lines about the progress of the expedition. As you know, Mr. C. F. Adams and myself left New York on May 1st. Having direct connection at Panama, we reached Guayaquil May 13th. Unable to find any convenient ship to take us to the islands, we had to stay at Guayaquil until June 1st, on which day we sailed on a schooner to Chatham, the most eastern island of the group, on which the hacienda of Senor Manuel Cobos is placed. We arrived at Chatham June 9th. Here we remained, examining the island and making extensive collections, until June 26th. From this date to August 26th, when we returned to Chatham, the following islands were visited: Charles Island (stopped at three different ports and went over the whole island), Hood, Barrington, South Indefatigable, Brattle (not landed), South Albemarle (opposite Brattle), Grossman (not landed), Duncan, West Indefatigable, Jervis, East Albemarle (opposite Cowley), West James, North James (two different ports visited), North Chatham, West Chatham.

On the second trip we intended to visit the following islands, and all arrangements had been made: Tower, Bindloe, Abingdon, West Albemarle, Narborough, Weismann, and Culpepper; but on my return here I found news from home which necessitated my return at once. Therefore I proposed to make only a short visit to the most important of the above islands—Tower, Bindloe, Abingdon—on my return to Guayaquil.

The following collections have been made: Mammals, birds (so far about 600 skins prepared by Mr. Adams, and the same number in alcohol), reptiles (many hundred specimens, complete series of Tropidurus from all islands), spiders, land shells, insects, etc. The flora I have collected as much as possible of every island touched at.

No mammals had been collected on these islands since Darwin's visit in 1835. Mr. Adams shot a bat on Chatham (the first one ever collected) and saw one on Albemarle. Hesperomys was secured on

Barrington (eight specimens), South Albemarle (one specimen), Duncan (one specimen), East Albemarle (one specimen); on Chatham one was observed. There cannot be any doubt that this mammal is an original inhabitant of the group.

The birds are exceedingly interesting, and I hope to be able to give a satisfactory solution of the Geospiza question. As I have shown in a paper published in the *Biologische Centralblatt*, the Iguanoid Tropidurus is represented by a single species on each island, and nearly every island contains a different species or race of Tropidurus. This has been absolutely sustained. Now in the plastic genera of birds we find exactly the same. Let us first consider the genera Nesomimus and Certhidea, of which only a single species is found on each island. The genus Nesomimus is represented by a different species or race on every island, and there is never more than one species or race found on one island. The same is true of Certhidea, but this genus is not quite so plastic. On Hood, as it is known, Nesomimus is much different from the other species; but so are Certhidea and Tropidurus. On the central islands—Chatham, Indefatigable, Jervis, James, Albemarle—Nesomimus shows only slight differences; but so do Certhidea and Tropidurus. What I want to state is the absolute harmony in the distribution and the grade of difference in these forms. This is also true of the flora, as far as I could make out.

It is now necessary to examine such genera as Geospiza, Camarhynchus, and Cactornis, which are represented by a greater number of species on one island. As it is well known, there has been a great uncertainty as to the number of species found one ach island; on some islands not less than eight species have been recorded.

So far as my present investigation reaches, probably on none of the islands visited is the number of species greater than three; but these three species vary nearly on each island, each separately, as if they would represent three different genera. The same view I have for Camarhynchus and Cactornis, and all such genera which contain more than one species of a genus on a single island,—like Bulimus, for instance. But often we find that the highest number of species is not reached by every island, but that the number of species is reduced. This can be explained by the extinction of one of the species. In this respect I have first to make some remarks about Nesomimus. As is known, Nesomimus existed on Charles Island in 1835 when Darwin visited the island; it still was found there in 1868 during Dr. Habel's visit. We did not see a single specimen on Charles Island, notwithstanding the whole island was crossed and three different ports were visited, and there is hardly any doubt that Nesomimus is extinct on Charles Island; and the same is true of Duncan. We have been all over the island, and not a single specimen was seen. On all the other islands Nesomimus was exceedingly common. It is highly interesting to see that Tropidurus is greatly reduced on Charles Island. During my whole stay there I saw two specimens, of which I was fortunate enough to secure one. I do not need to state that I took the greatest pains to find more. On Duncan only twelve specimens could be secured after long hunting. On all the other islands Tropidurus is exceedingly frequent. Exactly the same we find in such genera which are represented by different species on one island.

One or two, perhaps three, of the "three original species" may be extinct. This condition can only be explained by the subsidence theory, which, as I have stated in my article published in your journal, also gives the only satisfactory explanation of the harmonious distribution and differentiation of fauna and flora.

My opinion is that at the time when these islands were still in connection there existed already a great number of species of certain genera. As soon as separation begun each of these species was differentiated for itself, just in the same way as if it were a genus. It might happen that one or more, even all, of the species of such a genus became extinct on certain islands, or were not present there during the time of separation.[1]

Let us suppose the number of the species of Geospiza was four in the time when these islands were still in connection. These four species may be called $a$, $b$, $c$, $d$, and may be represented by *G. fuliginosa*, *G. fortis*, *G. strenua*, and *G. dentirostris*, which latter species I have not yet seen. $a$, $b$, $c$, $d$ is dependent on the different conditions on the different islands; taking three islands with the conditions $x$, $y$, $z$, we can express the species on these three different islands, which formerly were all in connection, in this way:

1st island, $a \times f(x) - b \times f(x) - c \times f(x) - d \times f(x)$
2d island, $a \times f(y) - b \times f(y) - c \times f(y) - d \times f(y)$
3d island, $a \times f(z) - b \times f(z) - c \times f(z) - d \times f(z)$

The greater the difference between $x$, $y$, $z$, the greater the time of separation, which may be expressed by $f(x)$, the greater will be the difference of the species. If one or the other of the species dies out, we can have, for instance :

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[1] I may state here the fact that North Chatham, which is separated from the principal portion by barren lava fields, does not contain a single species of Camarhynchus, nor Nesomimus, nor Certhidea.

$$\begin{array}{lccccccc}
\text{1st island,} & a \times f(x) & - & o & - & c \times f(x) & - & d \times f(x) \\
\text{2d island,} & o & - & b \times f(x) & - & o & - & d \times f(x) \\
\text{3d island,} & o & - & o & - & c + f(x) & - & o
\end{array}$$

This, I think, will be sufficient to express my opinion on the differentiation of such genera which contain more than one species.

Now some words about the birds themselves. Creagrus, of which, so far as I know, only four specimens exist in the museums, has been considered a very rare bird ; all the authentic specimens of which have been collected at Dalrymple Rock, west of Chatham. This bird is quite common here. We have seen it near Freshwater Bay, Chatham, between Charles and Hood, and found it in considerable numbers on the rocks in Gardner Bay, and on Gardner Island, near Hood, in hundreds of specimens; it was seen on Brattle, where many specimens were collected; it was also found on a rock north of Sullivan Bay, James, and on the Seymour Islands, north of Indefatigable. Creagrus is probably found on every steep rock which contains holes, in which the bird breeds.

On Albemarle, from which island only a few species of birds were known, we found over forty species (South Albemarle), a number greater than ever recorded from any island. *Geospiza magnirostris*, not observed since Darwin, was found on South Albemarle and Jervis ; it is simply the representative of *G. strenua* of other islands, as *G. conirostris* is the representative of this form on Hood.

I will conclude this letter with a few words about the reptiles. Of Tropidurus I have already spoken. Geckos were found in great numbers on Charles (one species, *G. galapagoënsis*), on Albemarle, and on Chatham. Snakes I observed on Hood (one specimen collected), Barrington, and Albemarle. Conolophus exists in great numbers on Barrington and the Seymour Islands, but was not noticed on any of the others. Amblyrhynchus is found on all islands, but is rare on some ; on Charles only two specimens were seen.

The land tortoises are extinct on Charles, Chatham, Barrington, and Jervis, on which islands they formerly existed. They are probably extinct on Hood, on which a thorough search of two days over the whole island was without result. They are said to still exist in reduced numbers on James (an examination of two days was without result) and on Indefatigable. On South Albemarle, where we remained twenty days, we found the land tortoises still in considerable numbers, but it is exceedingly difficult to reach the places where they live. We secured eight living ones, of different size: five with shells one meter or more in length, and one, probably the largest one ever taken from the islands, with the carapace one meter and forty centimeters in length. You may imagine the amount of work when I tell you that these specimens had to be carried from eight to twenty miles over the lava fields and through the densest brushwood.

I do not need to say that there was no possibility of bringing the large tortoises down alive. The largest one must have had a weight of 400 pounds. On Duncan we secured eight tortoises; they are much smaller than the forms from South Albemarle, and resemble the Abingdon specimens. On the northeast side of Albemarle I tried to penetrate to the interior, but had to return after two days on account of the nearly impassable lava fields.

So far I can say that the expedition has had the greatest success, and I am convinced that my expressed opinion on the origin of this group of islands is the correct one. I may add that in a single instance (near Barrington) I have found a land bird flying over the ocean; it was the common *Dendrœca aureola*, found on all islands. It is certain, therefore, that these birds do not travel from one island to the other, as is also fully sustained by the collections.

The birds are still as tame as formerly, especially on such islands which are not often visited. On Duncan a *Buteo galapagoënsis* sat down on a bush next to me. I touched him with a stick; he did not move. I began to tickle him on the head; this he seemed to like; and an hour later, when I had gone to a smaller island near that place, he also came over and sat down next to me to be tickled by the stick. Myiarchus is the tamest bird, and often sat down on my hat or my stick when I kept quiet.

I finish this letter, hoping that the expedition will be followed by others of the same nature. Biology is of the greatest importance for dynamical geology, and is in many cases the only source of information. The Fiji or Friendly Islands, which are considered as oceanic islands, but which I believe to be continental, ought to be examined, and also a group of islands which is doubtless of oceanic origin. Harmony or disharmony in the distribution of flora and fauna will always, I think, solve the problem of the origin. That variation goes on in definite lines, determined by the nature of the conditions, I am fully convinced. The theory of natural selection, especially the view of the "Neo-Darwinians," has not received any support; but more about this question later.

I left Chatham on September 1st for Tower Island. This island was very interesting, having never been visited before. Creagrus was found there in great numbers, breeding, besides Fregetta, Sula, and Phæthon. Of Fregetta a considerable number of embryos and nestlings were procured. Of land birds the following species were found: Geopiza, two species; Cactornis, one species; Nesomimus, one species; Certhidea, one species; Dendrœca, one species; the dove and owl were also observed. Not a single specimen of Tropidurus was seen; Amblyrhynchus is frequent, but small.

From Tower we went to Bindloe. All the birds collected by Dr. Habel were also obtained. Tropidurus is very common, and quite distinct from the Abingdon form. Nesomimus, which had not been recorded before from this island, is a very abundant bird.

On Abingdon we remained only a very short time. Nothing new is to be added to the results of Dr. Habel and the "Albatross."

We reached Guayaquil September 16th, and sailed to Panama on the 19th on the "Santiago."—G. Baur, *Clark University.*

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## GEOLOGY AND PALEONTOLOGY.

**The Desert Sandstone of Australia.**—A paper by Mr. Charles Chewings, published in the Proceedings of the Royal Geographical Society, June, 1891, contains the following interesting account of the "desert sandstone" of Central Australia:

"At what period or periods the Lake Eyre depression was formed has not yet been satisfactorily decided; but we may fairly conjecture that an opening at one time existed to the south into Spencer's Gulf. During Cretaceous times, however, that and all other outlets were things of the past, and the detritus from the Macdonnell and James ranges, as well as many other high lands, was washed into this large basin, of which, so far as ascertained at present, the outline extends from the Coast range, situated a little south of the Gulf of Carpentaria, westward nearly to the overland telegraph line. It then runs northeast towards Lake Eyre, and, skirting the Macdonnell ranges elevation, curves round to the north of the Charlotte Waters telegraph station, in about the latitude of Lake Amadeus, which lake it approaches, if not includes. This is probably the western boundary of this system.

"From Lake Amadeus the Lake Eyre system extends northeasterly towards Port Augusta, takes a curve to the eastward, and runs along